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CIFRA: Challenging the ICT Patent Framework for Responsible Innovation

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PREFACE

Social Sciences and Humanities (SSH) do not usually take a preeminent role in technical research projects. Sister projects arise as part of Horizon 2020 Framework Programme as a way to address this historical constraint and to allow SSH make a meaningful contribution to the shaping of the research agenda. To this regard, Sister projects are created to go beside the mainstream research in order to challenge existing biases in the research agendas and trying out more daring alternatives through the widening of imaginaries and by taking into account the SSH perspective.

CIFRA, as a Sister project, does not take the current status quo in the ICT patent ecosystem for granted, but on the contrary, explores the impact that potential new framings could have in ICT innovation and the value they could provide to the society.

Moreover, CIFRA project has addressed the ICT Patent ecosystem from the perspective of the Responsible Research and Innovation (RRI), thus with the aim of determining the way it can be better aligned with the values, needs and expectations of society.

1 INTRODUCTION

The 'patent' was created in the 15th century in order to balance the interests of society with those of the individual. Originally, patents were created with the purpose of rewarding inventors for their original, useful and not obvious inventions with the exclusive rights on the invention for a limited time in a certain territory. This classic patent model tried to create a 'virtuous circle' in which technological innovation drove further developments and progress EPO (2007). However, the patent system has faced some changes. This includes a wider range of areas that are now covered by patents; trivial inventions that have been granted a patent; territorial expansion of patents due to TRIPS[1]; and extensions of patent exclusivity by increasing timescales EPO (2007). As a consequence of the changes in the patent system, the system now faces some challenges such as the sheer increase of the volume of patenting activity, the increased number of sources generating Intellectual Property (IP); and the variety of complex technologies being covered by patents. These challenges to the patent system and unethical behaviors of patent applicants and patent holders have produced several problems such as patent fights, patent thickets, pendency issues, increasing costs etc., which shade the once 'virtuous circle' of patents. Despite the actions in generating solutions to the problems, such as patent pools, cross-licensing, compulsory licensing etc., the patent system and its legitimacy to prompt innovation for the benefit of society as a whole in the modern era is currently being questioned. However, some still advocate the robustness of the system of intellectual property rights like the other traditional schemes of property rights (e.g. Epstein 2010).

This deliverable provides a review of the ethical debate concerning the current patent system and its ability to fulfil societal objectives with a specific focus on the Information and Communication Technology (ICT) sector after a general introduction into the ethics of ICT. The paper provides a review of the societal impacts of the patent system, which until now,

[1] Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS)

has been mainly focused on patents in the pharmaceutical industry including, the patenting of stem cells and DNA. This paper focuses on the ICT industry and its impact on society concerning 'ethical issues' and 'open access' related to patents. These are two of the five aims of Responsible Research and Innovation (RRI) approach of the EU Program for Research and Innovation of the European Commission.[2]

Among the different intellectual property rights, the CIFRA project chose to focus on patents because patents are particularly relevant in ICT. We acknowledge upfront that findings might not be generalizable to other IPRs or industrial contexts.
The initial research was performed in the period from November 2016 to February 2017. It is limited to papers written in the English language. The search engines used were Scopus, WebofScience, ScienceDirect, and GoogleScholar to identify scientific work ethics and patents in the ICT sector. Due to the limited results obtained for the case of the ICT sector, the search was broadened to identify scientific work about ethics and patents in general. The search was conducted using several combinations of the keywords ("ethical issues", "ethics", "patents", "ICT", "information and communication technology"). The combined keywords were searched in Titles, Abstracts and Keywords with a timespan "All years". Search results across all search engines with all combined keywords produced more than 500 results. An initial filtering of results was carried out based on the titles and keywords. A second filter was then carried out based on the abstracts. After the second filter, a small number of results remained. Additional literature has been added through forward and backward search as well as using suggestions from research fellows. All the papers were systematically reviewed. Similar methodology was followed for literature on open access and patents. The search was conducted using several combinations of the keywords ("open access", "patents", "ICT"). Results were also very limited, for which extra literature was added through forward and backward search and suggestions from research fellows.

Due to time restrictions and parallel work with the other tasks in WP2, the work was based only on desk research only. Furthermore, the focus on patenting in the overall project and specifically in WP2 lead us to searches of ethical issues only in patenting as such and not on intellectual property rights in general. Here, the literature search about patents and ethics revealed a significant amount of studies, which have a strong focus on the pharmaceutical sector. Although, patenting in the pharmaceutical technology was very different from ICT in the past, we see two common trends. First, ICT is becoming more relevant in pharmaceutical research and the discrete character of pharmaceutical research and innovation are moving towards a higher complexity, which is the character of ICT research, but particularly innovations. Secondly, ICT, e.g. as emergency systems, is becoming as a kind of infrastructure more relevant for the survival of citizens, like life-saving drugs. Therefore, including pharmaceuticals as means to safe or expand lives into the analysis of the ethics of patents in ICT can be justified.

Following the valuable suggestions of the reviewers at the final project review in January 2018, we expanded – as suggested – our review in order to incorporate the literature about the ethics of ICT in general. Starting with a broad review of the literature using Web of Science, Scopus and Google Scholar, we identified around 65 sources, i.e. papers,

[2] The EU Programme for Research and Innovation of the European Commission https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation

conference proceedings (e.g. of ETHICOMP), book chapters and books. Furthermore, we approached via email established scholars like Rogerson, Stahl, Floridi and Gotterbarn, but also a younger scholar, like Simon, in order to ask for most recent relevant papers about the ethics of ICT. We received valuable feedback from four of them. This body of literature was used as basis for the new general chapter about the ethics of ICT in this deliverable, but also to complete the analysis in D 3.2 about the impacts of changes in the patent system by ethical ethical impacts in the assessment.

2 ETHICS AND ICT IN GENERAL

Since ICT has increasingly influencing our private and professional life, not only its beneficial aspects have to be considered, but also its threats, like unauthorized access to data, theft, cyberattacks, or the distribution of fake news. These phenomena raise not only economic, but also legal and ethical questions. Since it is unlikely that legal and technical constraints will be effective in preventing the risks generated by ICT, Rogerson (2011) argues that we must rely upon ethics combined with education and awareness. Besides addressing the negative aspects of ICT, such a comprehensive approach also facilitates benefiting from the positive aspects of ICT.

The chapter starts with the origins and definitions, followed by the major issues, the relevance of ethics in ICT practice and development. Then, the current major challenge of the ethics of ICT are elaborated before a brief outlook concludes the chapter.

2.1 ORIGINS AND DEFINITIONS

Rogerson (2011) elaborates the ethics of ICT starting with its roots and definitions. He goes back to the seminal and foresighted work of Wiener (1950), who put ICT into the context of fundamental human values. After decades of little research about the ethics of ICT, Weizenbaum (1976) addressed the threats of ICT, i.e. the decision making by computers without human compassion. Later, computer professionals in the US perceived the possible role of ICT in nuclear conflicts as a high risk. Since then the role of ICT and computer ethics has grown significantly (Bynum 2008). Finally, for Rogerson (2011, p. 603) ethics comprises both ethical practice, i.e. the conscious appeal to norms and values to which individuals are obliged to conform, and reflection, i.e. the elaboration of norms and values that are relevant for daily activities.

Relying on various definitions, Rogerson (2011, p. 606) defines “computer and information ethics … as integrating ICT and human values in such a way that ICT advances and protects human values, rather than doing damage to them which therefore must include the formulation and justification of policies for the ethical use of ICT and carefully considered, transparent, and justified actions leading to ICT products and services”. Recently, Stahl et al. (2016) have performed a comprehensive literature review on the “ethics of computing” based on an in depth analysis of more than 500 papers mainly published since 2000. They use the broader term “computer ethics”, because of the increasing integration of computing artifacts into other technologies and the environment as expressed in concepts, like ambient intelligence or ubiquitous computing. This broad diffusion of computers raised new ethical questions related to issues such as privacy, surveillance, autonomy, or ownership. They include in addition to computer ethics and information ethics ICT ethics, e.g. recently addressed, but not explicitly defined by Markus and Mentzer (2014), which is closer to our focus. However, the literature review by Stahl et al. (2016) reveals general ICT as the dominant technical dimension, which allows us with our focus on ICT also to draw on their findings.

2.2 MAJOR ISSUES

Among the core ethical concepts, collecting all issues of the broader discourse in moral philosophy the dominant ethical issue of ICT according to Stahl et al. (2016) is privacy, followed by autonomy, agency and trust. These core ethical issues constitute important topics of ethical discourses without being necessarily linked to particular ethical theories. Consequently, Stahl et al. (2016) distinguished these core ethical issues from fundamental and theoretical issues, which require a better conceptual and theoretical understanding. The largest subcategory in this area is that of epistemological issues related to the question of what is knowledge confirming that ethical judgments need to be based on an understanding of the social and natural world. For example, research in ICT can skew not only the factual understanding of ICT but also the way in which ethics in ICT is perceived. The second important set of issues is related to ontologies referred to the nature of being mainly referencing Floridi's information ethics (Floridi 2010). Another group of theoretical issues referred to particular moral values and duties, like friendship, honesty or sustainability. Further topics identified in the literature cover machine ethics, issues arising from specific ethical theories, moral status of technology or moral principles. All of these issues are related to rather complex philosophical and theoretical discourses and less to practical applications.

However, more than half of the literature survey by Stahl et al. (2016) focuses on social and practical issues of ICT including all those issues that have implications for the interactions of humans. These topics have a longer tradition in ethics and computing, like the largest category of professionalism and work-related issues. Another key issue is the relationship between computing and health as well as the topic of inclusion or digital divide also addressed by Rogerson (2011) as future challenge. In addition, this category includes practical questions on consent, which might be important in the context of personally identifiable data. In summary, this breadth confirms the influence of computing and ICT in general and the relevance of ethics in particular on all aspects of life. However, it also reveals the challenge to achieve a common understanding of the ethically relevant social consequences of computing and ICT, which can be seen in the numerous legal and regulatory conflicts.

The ethical issues linked to particular technical functions or artifacts is another category used by Stahl et al. (2016). Here, security is an important issue addressing technical means of security, which have an influence on the ethical acceptability of technologies. In addition, the design of technologies can affect ethical issues, incl. value-sensitive design trying to incorporate value considerations early in the design process. In addition, particular technologies, like the Internet, cloud computing (e.g. also Timmermans et al. 2010; Whitehouse et al. 2016; De Bruin and Floridi 2017) etc., generate ethical issues. The review by Stahl et al. (2016) identified generic ICT as the most relevant technology covering also computing, software and information systems. In addition to the Internet itself, related technologies and applications dominate the literature, but also Artificial Intelligence, health-related technologies, robotics, and social media attract ethical scholars.

Finally, half of the papers reviewed by Stahl et al. (2016) did not make explicit use of an ethical theory or concept. The other half covered a broad range of theories connected specific philosophers, such as Kant or Aristotle, but also Floridi. The most relevant ethical

theories referred to in computing and ICT are consequentialism, deontology, and virtue ethics. Most important moral values are justice, human rights, responsibility and respect for autonomy.

2.3 Practice and development

Obviously, not necessarily theory, but practice is dominating the ethics of ICT. The practice element of ethics manifests itself in methods and procedures adopted in the development of ICT systems, whereas the reflection element of ethics manifests itself in, for example professional codes of conduct, which are concerned with establishing what are the generalized ways of working that are acceptable to a wider community.

According to Rogerson (2011), process and product are the two ethical dimensions of ICT practice. The process dimension covers the ethics of activities of ICT professionals ranging from research over development to the delivery of products and services. Professional bodies include this ethical dimension in their codes of conduct guiding their members in doing the right thing for the right motive, e.g. by designing systems to increase their accessibility in order to reduce social exclusion. Results of professional ICT activities are products. Ethics in ICT should help to avoid both products being used for unethical secondary reasons and the implementation of additional over complex, but unwanted functionalities. Finally, Rogerson includes in his considerations also the interaction of non-human agents with humans, but also other non-human agents. The ethics focus of the product element is the technological integrity addressed by embedding ethics within ICT products themselves, e.g. by explicit opt-in procedures or by non-human actors following ethical principles.

ICT applications try to satisfy a particular requirement or need of organizations or individuals allowing them to realize specific objectives. Ethical considerations should assure that not only the interests of the initiators or owners of ICT systems, but of all directly or indirectly involved stakeholders should are considered. Furthermore, ICT systems should be designed according to the preferences of the users and not the other way round. The Design for All approach is one option to achieve this objective, in particular if implemented over the whole design cycle of products and services and taking both the direct, e.g. users, and indirect impacted stakeholders into account. However, all these needs are often difficult to turn into feasible design requirements and subsequent specifications. Furthermore, designers often lack the knowledge and supporting tools, which requires even more to provide designers with ethical guidelines (Roe 2007).

2.4 Challenges

In addition to the distinction between practice and development, Rogerson (2011) discusses the most relevant ethical aspects of ICT starting covering privacy, culture, crime and property. These topics have also been identified by Stahl et al. (2016) in their literature review and Markus and Mentzer (2014) in their foresight study about ICT ethics.

2.4.1 Privacy

Among the issues of ethics in ICT, privacy was already early addressed parallel to the expansion of the relevance of ICT, but is according to the broad literature review of Stahl et

al. (2016) still the most relevant topic. According to Rogers (2011), this is the case because privacy is a fundamental right of individuals and is an essential condition for the exercise in self-determination. For Collste (2008) privacy is seen as an instrument for sustaining autonomy, freedom and personal relationships. The dynamic development of ICT technology including the expansion of processing personal information has fostered the intrusion into privacy originally defined as control of, later as restricted access over personal information (Tavani and Moor, 2001). Meanwhile, the digitalized personal information can be easily transferred between computers and networks making them uncontrollable and generating data shadows creating further challenges for privacy. Finding the balance of the rights and interests of different parties related to privacy is challenging and depending on the context of the relationships, the trust between concerned parties and the principle of informed consent. For example, the protection of individual privacy has to be balanced with the needs of the government and businesses.

2.4.2 Culture

Computer and information ethics must cover also a cultural perspective, because the cultural groups and communities, we live in, are influenced by their relationship to ICT. On the one hand, ICT enables social institutions to function, whilst on the other, hand social institutions accept the use and development of ICT. Consequently, there is a two-way relationship between ICT and culture defined as the totality of shared meanings and interpretations of a given group or community (Rogerson 2011) in which ICT must be adaptable to culture and culture must be tolerant of ICT. Therefore, the professionals developing ICT must be culturally and ethically sensitive in order to deliver culturally acceptable products and services.

2.4.3 Law and crime

Legal issues covering regulations of ICT are another category. The complexity of the relationship between law and ethics is based on the one hand because ethics and shared moral beliefs influence the law to a significant degree. On the other hand, the law and its regulations can strengthen, but can also modify moral positions. However, there are also many examples, in which law and ethical beliefs do not converge or in which the moral assessment of the law is contested.

As ICT becomes more widely used and is used in more domains, the risk of misuse increases and the detrimental impacts of such acts are likely to be greater for society, organisations and individuals. The Convention on Cybercrime is the first international treaty seeking to address ICT-related crime developing a framework within which ICT-related crime, like offences against the confidentiality, integrity and availability of computer data and information systems, can be addressed:

Rogerson (2011) distinguishes two types of incidents, i.e. old crimes conducted using ICT as a tool, e.g. the illegal storage of images on a computer, and new types of crime made possible by specific types of ICT, e.g. gaining unauthorized access to an ICT system through hacking and releasing a virus to delete stored data.

Finally, ICT-related crimes have not only a legal, but also an ethical dimension. In creating law account must be taken of civil liberties, which are challenged, e.g. by the Convention on

Cybercrime, like the exchange of information between national governments. However, cultural differences in ethics are not taken into account by this convention.

2.4.4 Property

A specific case of law is the protection of property, whereas offences related to infringements of property ownership in general and copyright and related rights in particular are specific types of crime.

Ownership is defined as having control of the own property including the right to use it and to decide whether and how others can use it. Property covers not only tangible assets, but also intangible assets, like literature, music, movies, but also technological ideas and symbols or brands, which are protected by various types of intellectual property rights. Since most forms of intellectual property can now cover digital assets, it is an important topic in computer and information ethics (see the literature review by Stahl et al. (2016)). In particular, the ownership over software is controversial as well as whether copyright is sufficient or additional patent protection is needed. On the one hand, it is argued that software developers need as well as other creators of technological knowhow sufficient incentives in form of intellectual property rights, which allows them to sell or license the software exclusively. On the other hand, Stallman (1992) questioned the current forms of software ownership, because they restrict the creativity and invention of software developers, which is also harming the society as such. Therefore, he promoted software being freely available for everybody via open source licenses. His claims can also be seen as starting point for the open source movement.

Since copying digital intellectual property is rather easy and cheap, their owners face significant problems to sell, lease or rent profitably their digital contents. Prominent examples are peer-to-peer platforms exchanging illicitly music or movies, which is questionable not only from a legal, but also ethical perspective. In summary, if software can benefit society as a whole, conflicts occur between the owner, who has the right to exploit the product commercially, and society, which has a general right to access and benefit from the software. Therefore, not only from an economic, but also from an ethical perspective, a balance has to be found that balances the competing interests by answering the question of who owns and who has the right to modify, distribute or use software.

2.5 Outlook

Besides the continuous dynamic and diverse technological developments in ICT (e.g. Markus and Mentzer 2014), which challenge ethics in ICT in general, some specific developments are worth to mention (Rogerson 2011). Globally uniform ICT might create further tension to the still regionally diversified ethical attitudes or the convergence of ICT might be followed by the convergence of ethical attitudes (Colleste 2008). ICT can be beneficially for all members of society. However, the current existing digital divide might be further accelerated by the even more complex and challenging ICT as supported by the review of Stahl et al. (2016). Despite its dynamic development in the past, it appears that ethics of ICT has far from exhausted its potential uses and implications for emerging ICT technologies such as the Internet of Things (e.g. Popescul and Georgescu 2013).

Finally, Stahl et al. (2014) call for a further development of the ethics of ICT towards to the concept of Responsible Research and Innovation (RRI) in order to generate practical relevance and influence of ICT research and design, but even policy and practice. Therefore, also Stahl et al. (2017) recommend implementing the principles of anticipation, engagement, reflection and action following the framework developed by Stilgoe et al. (2013). In particular, the research about the ethics of ICT should lead to practical recommendations. Therefore, research about specific forms of ICT and concrete ethical issues should be prioritized compared to generic work on ICT and ethics.

3 OVERVIEW OF ETHICS AND PATENTS

3.1 INTRODUCTION

Recently, Plomer (2015) argues that 'the global patent system is spectacularly failing to facilitate realization of the human rights ideal of universal access to science'. If this is to be rectified, a 'fundamental restructuring of patent institutions is required to facilitate democratic oversight of patent policies and their compliance with human rights and to ensure meaningful realization of the right of everyone to access the benefits of science'. In the United States, the problem is that the policy of the USPTO has been to grant patents far too easily. Moreover, it was many years before the US Supreme Court pushed back against this liberal policy by ruling in the Myriad Genetics case that isolated naturally occurring genes are not patentable subject-matter. In the meantime, genetic research and the development of alternative (more affordable) diagnostic tests was stifled by patents such as those held by Myriad. In Europe, the problem is rather different. It is that, in cases such as WARF (at the European Patent Office [EPO]) and Brüstle (at the CJEU) the processes and products associated with pioneering stem cell research are being excluded from patentability by a conservative conception of human dignity. So, on one side of the Atlantic, the patent regime has been slow to adjust its underlying utilitarian balance; and, on the other, the benefits of innovative medical research are being jeopardised by a dignitarian morality. In neither regime are the ideals of human rights shaping patent policy and practice in the right way.

Especially, the ethical issues of the IP rights (IPR) in general and of patents and the patent system in particular, are currently under discussion. Already De George (2005) explains the current IPR and patent discussion as a confrontation between the critique against the Standard Argument defending IPRs and the Status Quo Approach.[3]

The Standard Argument as called by De George (2005) is made of two consequent arguments: fairness and justice as well as profit. The fairness and justice argument defends the efforts invested by the inventor such as time and money in creating a product/process or an expression of an idea for the benefit of society. It argues that inventors should be allowed to receive an exclusive return on their investment and contribution to society, if society is willing to pay for it. As to the profit argument, it argues that the length of time for the exclusive rights should be long enough to allow inventors to recover their investment and make a profit from their invention. It claims that only by ensuring the comprehensive length of time for a return, inventors can be motivated to invent.

The Status Quo Approach as called by George (2005) is the use of IPR and patent law by the industry to set the suitable parameters needed to protect and increase the profits of its companies.

[3] See Watt (2007) in the discussion about software patents taken by industry to reply to critics on their policies with moral approach.

Both the Standard Argument and the Status Quo Approach are under criticism for their ethical consequences. As mentioned by De George (2005), the critique is not based on patent protection being developed in an unethical manner, but rather it is one of many sets of ethical justifiable ways of protecting an industry´s interest.

This section presents an overview of the discussion of ethics and patents in general. It studies the ethical issues in patents for the pharmaceutical industry, which has a longer tradition in ethical confrontation. The case of the pharmaceutical industry is presented in order to identify key issues that could be later translated into the ICT sector as well as some potential ethical consequences of the current patent system. In addition, this section presents some potential consequences of the patents and some ethical questions on the future scenarios of the patent system.

3.2 LEARNING FROM THE PHARMACEUTICAL INDUSTRY

In order to understand the concerns related to ethics and patents in the ICT sector, it is useful to analyze other sectors with a longer history of contention, such as the pharmaceutical industry. The pharmaceutical industry is perhaps the best case to observe the different views on our current patent system.

Within the pharmaceutical industry, consumer and industry interests are not aligned. Pharmaceuticals belong to a sector in which the consumer´s side is of major importance because it is a matter of health and life and thus their aims at profits and controlling the access to medicines is a contentious issue.

The pharmaceutical industry has one of the highest level of expenses related to lobbying. It is also quite succesfull and therefore makes it difficult for governments to decide in a balanced way between consumers' and the industry's interests (De George 2005).

In the pharmaceutical industry the 'Standard Argument' and the 'Status Quo Approach' are being used for the benefit of the pharmaceutical companies (De George 2005). For instance, the Standard Argument is used to justify the incremental increase in the price of medicines. The Status Quo Approach is used to extend the length of the patents, to extend patent protection and to legally substitute their ethical responsibility with social actions e.g. giving away certain medicines instead of developing new ones for poor countries.

The general complaint is not directed towards the Standard Argument itself, but rather regarding the fact that the benefits for society as a whole depends on the amount of profit pharmaceuticals can earn from having the IPRs, in particular patents of a medicine. The profit determines the access, price and the investment in further R&D for new medicines (Parker-Lue, Santoro, and Koski 2015). This situation produces criticisms including, the increasingly high profit margin of the industry, high costs of drugs and international policies related to developing countries influenced by the pharmaceutical industries (e.g. Lea 2008 and recently Timmermann and van den Belt 2013).

Central to this 'conflict' between parties is the differing perspectives and mode of communication. One is rooted in ethics, the other in law and economics (e.g. recently by

Oppenheimer, LaVan and Martin 2015). The former is referred to by the critic, focusing on rights and common goods. The latter is spoken by the pharmaceuticals and focuses on the Standard Argument and Status Quo Approach.

The conflict is one of rights. On the one side, is the right to health and health care. On the other, the right to own intellectual property. One important issue that requires mentioning, is the difference between the right to health and right to health care. The first one refers to the necessary conditions that governments are obliged to provide their citizens in order to ensure good health e.g. clean air and clean water. The second one refers to a government's obligation to provide medical care including medicines. How this is provided varies between countries.

Despite the significant role pharmaceutical companies play in the provision of health they do not bear the full responsibility regarding satisfying the right to health care. This obligation is shared among all. However, governments carry the primary responsibility in providing health care to their citizens. The pharmaceutical industry's ethical obligation in terms of the health care system are noted by De George (2005) to involve the 'Production Obligation' and the 'Access Obligation.' The Production Obligation is the obligation to develop and produce new beneficial medicines. Access obligation is the obligation to make medicines available to those who need them. Both obligations are tightly knit together, as simply developing medicine does not produce a social benefit if it cannot be accessed by those who need them. Some criticisms regarding these obligations are related to the contention that certain life-saving medicines are not produced because those who need them are in poor countries, which for the pharmaceuticals means low profits due to lower prices (Schweitzer and Comanor 2011). Other criticisms relate to the pharmaceutical industry and the market, which seem to fail (as a result of high prices) the obligation of giving access to medicines. However, in regards to access, governments have a stronger obligation than the pharmaceutical industry have to ensure it. Governments are obliged to implement correct policies and to make sure that medicine is affordable. Yet governments, especially those of poor countries are not always able to meet this obligation. One reason is the 'Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS)', where developing countries have been required to adopt developed countries' level of IP protection.

There are two main issues regarding the pharmaceutical industry and access: Firstly, the high and continually increasing price of patented medicines (Attaran and Gillespie-White 2001). Secondly, the illegitimate attempts by pharmaceuticals to extend the time of the patents they have in order to ensure market control (Rossi 2006). The response given by pharmaceuticals to all complaints about the high prices are the Standard Argument and Status Quo Approach. Another questionable issue regarding patents and access is the 'one-size-fits-all' approach of patents. Patent laws are equal for all products and processes without consideration of their differences.

In conclusion, the pharmaceutical industry's defense, which is based on property rights and on economic arguments, is insufficient and only protects the profits of IPR holders in general and patent owners in particular. Neither the right to profit nor the Standard Argument and Status Quo Approach give the right to access, or enforce the common good or the obligation

to aid. Thus, the status-quo of the IP rights should be carefully reviewed and perhaps adjusted to provide more balance between IP rights with the rights of access and the common good.

Contention surrounding the legitimacy of patent protection is also strong when the protection covers the use of genetic material even if the patenting entity it is not a corporation. To this regard, emblematic is the case of John Moore vs the University of California (Mehlman, 2004). In the 1970s Moore underwent a treatment for leukemia at the UCLA medical center. To their great surprise, Moore's doctors discovered that the patient's splin tissue produced a protein that was useful in the fight against cancer. Without further informing Moore or obtaining his consent, researchers from the University of California proceeded to create a cell line from Moore's tissue which was subsequently patented. As of 2005 the market value of the patent covering the cell line was estimatemad around $3 billion dollars (Amani & Combe, 2005). Moore didn't learn about UCLA "invention" up until 1984 when he finally filed a lawsuit against the regent of the university. Nevertheless, despite finding the doctors guilty of breaking their fiduciary duties by failing to reveal their financial and research interest in the cell, the California Supreme Court ruled against Moore's property claims. The court ruled that Moore's cell constituted raw genetic material and that, given the lack of authorial investment to generate it, any proprieratary claim over it was to be consider invalid.

This verdict is problematic because despite recognizing the potential problems related to people ownership claims on their genetic material, it still considers the use of said genetic material for profit purposes as acceptaple and therefore as worthy of patent protection. Furthermore, the ruling of the California Supreme Court constituted a legal precedent that later allowed the government of the United States to seek patent protection for a cell line extracted by an Indian woman (Ching 1997; Khan 1999).

This second case attracted considerable public attention and generated a sizable amount of protest, that later forced the American government to withdraw its patent claim. The case also highlighted the emerging tension between the ethical and moral norms held by society over the use of genetic material, and the rules of intellectual property protection which characterize western patent systems (Amani & Combe, 2005).

3.3 POTENTIAL ETHICAL CONSEQUENCES OF PATENTS

As mentioned, the aim of granting patents has been to balance the interests of society with those of the individual company. However, the system is imperfect and offers some space for unethical behavior from those holding patents. The following issues are the ethical consequences of patents (Etikko 2016):

- Unfair monopoly on humankind's collective heritage (e.g. a patent on genes);
- Fragmentation of IPRs, in particular patent thickets, patent wars, patents blocking innovation;
- Exclusion of others from important knowledge (knowledge protectionism);

- Reduction of access to medicine or other essential benefits for poor people (market control);
- Unfairness for new and smaller market players (e.g. a higher litigation risk);
- Prevention of information being disclosed to the contributors (i.e. participants in clinical trials)
- Bio piracy (i.e. taking resources from poor countries without returning them);

A further economic explanation of the drawbacks of the patent system is given in section 3. of the Deliverable 2.1 "Literature Review" of this project.[4]

Ethical aspects arise from exclusivity. This can be categorized within the 'public availability dimension' and the 'legitimate ownership dimension' (Etikko 2016). The public availability dimension refers to whether a patent will prevent potential users from benefiting out of the invention. The legitimate ownership dimension raises the question as to whether the inventor deserves exclusive ownership rights to the invention. The critique of the latter depends on the invention's origin and whether the invention should be considered as part of humankind's collective heritage.

3.4 KEY QUESTIONS OF THE FUTURE SCENARIOS OF THE PATENT SYSTEM

"The increasing pace of scientific and technological developments as well as the new forms of convergence and interdisciplinary will continue to create more debates touching on the justifications of the patent system. The challenges are both technical and ethical." Bert Gordijn, Department of Ethics, Philosophy and Medicine, University of Nijmegen (EPO Interview) EPO (2007)

The future of the patent system is uncertain. It is expected to become more complex and unpredictable due to a number of driving forces, such as power at the national and international level, globalization, rate of change difference of political cycles, market, environment, systemic risks due to interconnected systems; and the ever increasing accessibility of knowledge.

This uncertainty has led to the study of possible different future scenarios for the patent system at the global level EPO (2007). The scenarios in which the future world of patenting and IP could evolve depends on what the driving force is. The scenarios are those in a world where the dominant driver is: (i) business; (ii) geopolitics; (iii) society; or (iv) technology.

For each of these scenarios a number of ethical questions arise. Some of these questions are listed as follows EPO (2007, p.11):

- Does the patent system offer business protection in the face of ever-increasing competition?
- Does the patent system allow fair market competition to new businesses?
- Does the patent system serve the world's various interests fairly?

[4] CIFRA: Challenging the ICT Patent Framework for Responsible Innovation. Call: H2020-ICT-35-2016. European Commission - Horizon2020 founded project. CIFRA Consortium 2016-2017

- How can public and private interest in IP be reconciled for the benefit of society?
- How are the ethical and moral dilemmas raised by technology reflected by the patent system?
- Where should the limits to patentability be drawn? By whom?
- Does the patent system benefit society?
- How can the patent system prevent unethical behaviors from patent holders?

The patent system is already dealing with some of these questions which responses are fundamental for the well-functioning of the system as a whole.

4 REVIEW OF THE LITERATURE ON ETHICS AND PATENTS

4.1 LITERATURE OF ETHICS AND PATENTS IN GENERAL

This sub-section includes literature analyzing the ethics of patents. Although the literature is not specifically focused on ICT, the various analysis' is relevant since these could be further translated into the ICT sector.

4.1.1 Economic justifications for patent protection

Karbowski and Prokop (2013) make a critical retrospective analysis of the economic arguments for the patent protection of inventions and for the use of patent protection laws in business strategies. The different arguments of the discussion on patent protection are discussed by the authors, which include nature law, reward in form of a temporal monopoly, incentives created by the monopoly profits, and compensation for revealing the secret. Regarding the strategic behavior of some companies in the field of patent law, the results show that patents rights have been misused by companies in the form of `shelving' or `parking' of patents, using patents as `bluffs' or `decoys', the declaration of patent `battles' or `wars', applying for patents that are too broad in scope or invalid. The use of these business strategies are possible to have caused diverse negative economic effects on total welfare. For instance, the development of a high-tech industry can be hindered by a patent war, whose only goal is to limit the competition, protect market share and waste resources.

In addition, the analysis highlighted that there has been an awareness for a long time of the resulting effects of patent law. In nineteen-century economics one was extrememly engaged in the fundamental discussion regarding the protection of intellectual property rights. However, interest was lost due to the "protectionists". Since then, the issue has been overtaken by lawyers, engineers and historians who supported the temporary monopolies granted by patents.

The study is driven by the urge of re-opening the *"debate on the shape and functioning of the patent system, and to return to the fundamental discussion on the protection of intellectual property rights"* (Karbowski and Prokop 2013). It aims at opening the question "whether the existing legal protection of the inventions is not too costly in comparison to the benefits it was supposed to generate for the economy".

The paper makes a critical analysis of the patent system and of the ethical issues given by the misuse of the patent´s law.

4.1.2 The conceptual problem

Straus (2015) discusses patents and copyrights, noted as the main concepts underlying intellectual property. Today´s economy is knowledge-based, described as an 'intellectual property economy' or 'intellectual capitalism`, making intellectual property to be very important in today´s society. The author performs an analysis of the historic roots and justifications of patents and copyrights. He also presents the modern critics of intellectual property rights, putting emphasis on ethical aspects as wel as the conceptual problems associated with intellectual property. Some critics state that:

> *"…increasing scope of patentable subject matter or legislatively creating new forms of abstract objects, such as plant variety rights, constitutes effectively the creation of capital, which has the danger that it can act as an enormous power resource for a select few…"*
>
> *"…global protectionist scheme for intellectual property would help to promote the formation of global factions, resulting in the danger of global rent seeking, and perhaps providing temptation to multinational elites to increase their profits through the simple stratagem of persuading a supranational body to elevate levels of protection for abstract objects already in existence…" (Straus 2015, p.264).*

The analysis made, presents a considerable change from the original concept driven by the historical developments in science, technology, society, economy, and politics. By taking the cases of genetic inventions, the author presents how the boundaries of no patentable discoveries and patentable inventions are being blurred. New questions on how to deal with intellectual property rights fairly at an international level have been raised as a consequence of major institutional reforms of intellectual property rights (e.g. those affected by the TRIPS.

By presenting the historical change of intellectual property concepts, the paper presents a good analysis of the conceptual problems of the current system as well as the challenges society is facing at the international level.

4.1.3 Patents and ethics: Is it possible to be balanced?

Spławiński (2005) shows that many inventors are violating the basic principles of patenting namely, using patents as an unfair instrument against society. Indeed, the inventor´s desire to profit from their invention is confronted with ethical concerns. The paper presents the issues given by the misuse of the patent protection law: the submission and grant of invalid patents and broad patents. It uses medical examples to present the problem and the negative consequences for society.

Broad patents can block research and compromise the competitiveness of companies, since there is only one market owner. Consequently, there is a delay in progress due to low incentives from the patent owner for further research. Invalid patents cannot only obstruct

progress, but can also endanger life especially, in the case of medical developments.

Spławiński (2005) presents cases when patent law is misused by the patent holder. It points to the ethical issues and consequences of the actions but fails to propose any solution. However, the arguments can be easily translated to the ICT sector.

4.1.4 Ethical issues surrounding intellectual property

Sonderholm (2012) presents an overview of the ethical problems raised by intellectual property rights suggested by contemporary philosophical and interdisciplinary literature. It focuses on IPRs and the problem of access and availability. The access/exclusion problem, which is excluding a certain group of people from the market, is said to be morally contentious with regards to life-saving medicines. Not so much however, in other areas such as computer software, music or movies. This is due to the fact that profits in an IPR and particular patent driven regime are generated only from sales and licensing revenues. Thus, pharmaceutical companies have no economic incentives to invest in the R&D for drugs that would mainly be sold in low income countries. This problem may also be seen in higher income countries as licensing agreements involving parties that both aspire to develop the patented innovation into a product line generate a conflict of incentives in knowledge sharing and knowledge transfers. As the licensing party and the licensor will engage in competition based on the same underlying technology, the licensor has benefits from licensing the same innovation to a larger number of licensees (Fosfuri, 2006). Yet, in the absence of a larger number of potential licensees, the licensor may find it less profitable to engage in licensing, thereby creating an entry barrier.

Two standard solutions to the access problem are presented: 'differential pricing' and 'compulsory licensing'. The former proposes to sell an IP protected product at different prices in countries with different level of income. The latter proposes governments to issue production licenses for IP protected innovations required to tackle public health emergencies. However, both solutions are not perfect. `Differential pricing' promotes the smuggling of cheap medicines from low-to high income countries. It's unfair, if it benefits rich people in poor countries and harms poor people in rich countries. `Compulsory licensing' has long term social costs such as "a risk that compulsory licensing will reduce the research-driven pharmaceutical sector's incentives to innovate" (Sonderholm 2012, p.1110) among other risks, as for instance such regulatory efforts usually target the most valuable patents of a company that hold the largest potential to transform an industry or introduce radical changes (Shapiro, 2004). In order to address the incentive issue while also providing access to key patents required for further developments in a field through compulsory licensing, the party subject to compulsory licensing may allow its patent to be accessed by commercial researchers in exchange for a licensing fee that is contingent upon the financial success of the licensed patent (Gitter, 2001). Since neither of the two standard solutions presented alleviate the access problem given by IPRs, additional options to mitigate against the problem have been found in the literature. An interesting finding is the `Pogge and Hollis' Health Impact Fund (HIF[5]), which offers the choice to the patent holder between exercising the usual patent rights or registering the product with the HIF. The HIF secures a profit cost by government investment. Consequently, the author also analyses the two defenses of the ethical legitimacy of IPR: the libertarian Narveson (2005) and the

[5] Pogge and Hollis' Health Impact Fund http://healthimpactfund.org/Old/hif_book.pdf

cosmopolitan Pogge (2005). From the conceptual point of view, the author suggests libertarians refuse Pogge's argument, where a "libertarian argument in favor of IPRs can only yield the conclusion that innovators have property rights to the physical token of their innovation, then libertarians seem to be committed to the view that an author only has a property right to the physical token of the book she is writing and not any copies of it" Sonderholm (2012, p.1114).

Sonderholm (2012) discusses well the problems associated with certain solutions and the different weaknesses in the defense of the ethical legitimacy of IPR. Although the paper focuses on the health sector, the issues covered can be also be analyzed with consideration to other sectors.

4.1.5 Defending patents

Drysdale (2004) defends patents in the biosciences. He suggests that the issue is not the patent system but rather, the ethics of the inventions. The author says that the problem of patents in the biosciences is the fact that it is an emotionally charged field, where the public feels threatened yet, with incomplete information on issues and field. These situations lead to misconceptions.

Two misconceptions about patents and the role of the patent system are mentioned by Drysdale (2004). Firstly, the patent system does not allow life to be controlled by anyone. This means in the case of the biosciences, that an owner of a patent for a gene cannot change nor owns the humans who already have that gene. The patent holder has a right over the gene in isolation. Secondly, the patent system is not a system of ethical approval. Regarding the second point, the institution that decides on the ethical acceptance of an invention (patented or not) is the government through its regulatory body and not the examiner at the patent office. The author is also critical regarding the European patent system, which is entirely dependent on the national laws of each member state.

The author defends the patent law and patents in bioscience and argues that ethical issues do not belong in the current patent system.

4.1.6 Patenting 'just' ideas is not just

The lack of clarity of whether an invention is primarily the act of having an idea or instead, to also be able to build this idea, is a weakness of the current patent system. It gives rooms for unethical behavior. Lemley (2015) studied the negative effects of this term´s lack of clarity. The author points out that the current patent system promotes the filing of ideas rather the filing of practical implementations of those ideas. He argues inventors are motivated to not further develop their ideas before obtaining the patent, since it is not necessary to invest time and resources before obtaining the monopoly of the idea. The consequences of filing ideas are broad patents and patents over inventions which have not been proven to function. The broad patents can give the inventor power over a wider number of inventions and can prompt patent trolls. Lemley (2015) argues that this practice is unfair to those inventors who have taken the time and investment to also put into practice their inventions and thus a shift in the patent law should take place by which proven and defined patent filings are favored over those lacking those attributes.

In a similar vein, the current patent system allows for many non-novel innovations to gain patent protection at the end of the application process (Shapiro, 2004). This introduces a further workload to the patent system that already has had an "explosion" in the number of litigation cases (Bessen and Meurer, 2006). Benefits of having pending patent applications in new technology subfields have been documented in the innovation strategy literature, such as through ease of access to venture capital (Cockburn and MacGarvie, 2009). The positive public reaction to patent applications in novel patent classes, along with the long period before the disclosure of key information about the novelty and claims of a patent application, creates incentives to apply for patents that will not be granted at the end of the application procedure (Koenen and Peitz, 2015). Since it does not eventually target the development of a innovation, such patenting behavior raises questions on ethical grounds, although not contradictory to the procedures of the patent system.

The issue of patents that are too broad is particularly critical in the software field were patents seldomly contain source code and are often defined in terms of user benefits (Hall and MacGarvie, 2010). Software patents have for long puzzled patent authorities due to their caracteristics (Zivojnovic, 2015). On one hand in fact, all software consist of algorithms which are a series of logical and arithmetical steps performed on a given database. Due to their nature of abstract ideas, the jurisprudence normally considers algorithms to be non-patentable. On the other hand, however there is no controversy that the implementation of abstract ideas can be granted patent protection. This is the case of all the machines programmed with software with which we interact in our daily lives.

The tension between the nature of abstract ideas of software and its tangible application has generated a considerable amount of confusion with regard to which claims are legitimate and therefore can be granted patent protection. Zivojnovic (2015) examines the evolution of the jurisprudence on the subject matter. He notes that courts have progressively become more strict in their evalution of which claims constitute patentable matter. In particular he examines the 2014 ruling of the U.S. Supreme Court in the case of Alice Corp. Pty. Ltd. versus CLS Bank International. In the sentence regarding the case the Supreme Court stated that including the words “apply it with a computer” to a patent-ineligible abstract idea is not sufficient to be granted patent protection. As a consequence of this sentence the author expects that many of the software patents currently in circulation would be invalidated in case they are challenged.

4.2 Ethics of ICT Addressed by The European Commission

The European Commission has taken some actions regarding the ethics of ICT. Some of the initiatives of the Commission include the Opinion No. 26 Ethics of Information and Communication Technologies[6] of the European Group on Ethics in Science and New

[6] EGE (2012) Opinion No. 26 Ethics of Information and Communication Technologies. Brüssels. http://bookshop.europa.eu/en/ethical-aspects-of-information-and-communication-technologies-pbNJ3111428/.

Technologies (EGE), the ETICA project[7], and the Article 53 (c) Exceptions to patentability[8] of the European Patent Convention (EPC). However, the ethical issues of patents in the ICT sector has not been yet covered.

4.2.1 Opinion No. 26 Ethics of Information and Communication Technologies by the European Group on Ethics in Science and New Technologies (EGE)

In the Opinion No. 26 the European Union regulatory and policy frameworks and ethical aspects of ICT are presented. Regarding the former the focus of the Opinion is on issues on internet governance: international bodies like the UN Internet Governance Forum, UNESCO Code of Conduct for the Information Society, Organization for Economic Cooperation and Development Council of Europe, ICANN[9] , the EU policy regarding ICT, current EU Regulatory frameworks for personal data protection, and the gaps or deficits in regulations and policies. For the ethical aspects the focus of the Opinion is on challenges to the concept of identity, and privacy as a fundamental right. The report does not address issues related to IPR, because it was intended not to interfere with the at that time on-going negotiation of the Anti-Counterfeiting Trade Agreement (ACTA).

The Opinion of the EGE deals with the ethical problems in general with a focus on Internet technologies. It presents similarities in the ethical issues arising from the use of ICT in health, government, education, agriculture and commerce as they impact on society and individuals.

The EGE (2012) has grouped the 'ethical concerns' regarding ICT in following groups:

i) a person's identification using ICT, and the development and/or continuous re-interpretation of one's personal identity, in the media made available by ICT;
ii) the changes of the social sphere, particularly concerning social relations, culture, education, environment, and e-governance;
iii) the new possibilities of political participation and practices of citizenship using ICT; and the
iv) the sphere of e-commerce.

Additional issues to add to the Opinion No. 26 would be: i) the access to the technology by poor countries; ii) the invasion of individual and corporate privacy; and iii) values preservation and accountability for the consequences are also concerns in the ICT sector.

4.2.2 The ETICA project

The EU financed[10] ETICA project was a research project which run from April 2009 to May 2011 on *"Ethical Issues of Emerging ICT Applications"* ETICA-Project (2011). The main

[7] ETICA Project - ETICA Stands for "Ethical Issues of Emerging ICT Applications." www.etica-project.eu/home.
[8] EPO - Article 53: Exceptions to Patentability. www.epo.org/law-practice/legal-texts/html/epc/2016/e/ar53.html
[9] Internet Corporation for Assigned Names and Numbers
[10] The ETICA project was funded by the European Commission under the 7th Framework Programme (GA 230318)

objective of the project was to "*identify ethical issues of emerging technologies and their potential application areas in order to analyze and evaluate ethical issues arising from these".* The outcomes of the project are a series of recommendations on *"how to engage with the ethics of emerging ICT in a proactive and acceptable manner".*

The findings[11] of the project showed that ethical issues are technology related. However, issues related to privacy, data protection, intellectual property, security are recurring in all technologies. Some ethical issues that are less obvious and currently not regulated were also identified, which include: autonomy, freedom, agency, possibility of persuasion or coercion, responsibility, liability, the possibility of machine ethics, access, digital divides power issues consequences of technology for our view of humans, conceptual issues (e.g. notions of emotions, intelligence), link between and integration of ethics into law, culturally different perceptions of ethics.

The project´s findings have been used as base for follow-on projects. For instance the *UK EPSRC funded project on a "Framework for Responsible Research and Innovation in ICT"*[12], which main outputs include the Observatory for RRI in ICT[13]. However, searches for IPR and patents did not reveal any relevant results.

4.2.3 EPC Article 53 (2016) Exceptions to patentability

The European Patent Convention addresses ethical aspects in its Article 53 (c) by defining the exceptions to patentability in the European Union. European patents shall not be granted in respect of:

a) inventions the commercial exploitation of which would be contrary to **"ordre public" or morality**; such exploitation shall not be deemed to be so contrary merely because it is prohibited by law or regulation in some or all of the Contracting States;
b) **plant or animal varieties or essentially biological processes** for the production of plants or animals; this provision shall not apply to microbiological processes or the products thereof;
c) **methods for treatment of the human or animal body** by surgery or therapy and diagnostic methods practiced on the human or animal body; this provision shall not apply to products, in particular substances or compositions, for use in any of these methods.

However, there are no further links to ethical aspects of patents in general nor to ICT patents in particular.

[11] European Policy Brief Ethical Issues of Emerging Information and Communication Technologies (ETICA) October 2010 http://www.europarl.europa.eu/meetdocs/2009_2014/documents/stoa/dv/6jb_etica_pol_brief/6jb_etica_pol_briefen.pdf

[12] UK EPSRC funded project on a "Framework for Responsible Research and Innovation in ICT" http://gtr.rcuk.ac.uk/projects?ref=EP%2fJ000019%2f1&pn=0&fetchSize=10&selectedSortableField=firstAuthorName&selectedSortOrder=ASC

[13] Responsible Innovation in Emerging ICTs https://digitalenlightenment.org/sites/default/files/users/14/BernrdCarsten.pdf http://www.orbit-rri.org/category/ethical-issues/

4.2.4 Summary

Although there are a few initiatives at the European level to address general ethical aspects related to ICT, there is obviously no explicit link between these initiatives and the ethical aspects of IPR or patents in ICT in contrast to the more established and elaborated literature about the ethical implications of patents in medicine and pharmacy.

4.3 Literature on ethics and patents in the ICT sector

This session includes a review of the main issues on ethics and patents cover by the literature focusing on the ICT sector.

4.3.1 Software Patents

In the field of software specially, but also more broadly in the field of computer-implemented inventions (CII) see Figure 1 the issue concerning patents is quite sensitive.

The dispute begins with critics on whether the CII should be patentable or not. The argument against patentability is that CII are not inventions, but rather a product of creative work. Another, issue is the diversity of practices for patenting CII adopted by patent offices around the world, and the consequences that this lack of harmonization could create in the market, i.e. the number of patent CII filling has increased steadily in the last two decade reaching one-third of all filling at EPO by 2011.[14] In contrast, Bessen & Hunt (2007) report only 15% for the USPTO.[15] Furthermore, that CII are found in many sectors apart from the ICT sector, such as manufacturing, automobile, etc. Thus, any ethical issue from a software patent holder could have significant effects in multiple sectors.

Frietsch et al. (2015) studied whether abolishing the patent protection for CII would affect the international competitiveness German and European companies. Although of the skepticism towards CII patents Frietsch et al. (2015) found out that German companies are satisfied with the current legal situation of the patentability of CII inventions. Moreover, the authors found that any changes in the current patent system would lead to important alterations in the economic system of Germany and other countries. In the study is also showed that other substitution to patents such as copyright are seen as not adequate to protect the full invention. Furthermore, it would reduce the motivation and incentives to invest in R&D (the already known Standard Argument). This is opposite to the proposal of Stark (2005) arguing for the use of copyright instead patents in the software industry (like already advocated by Pfaffenberger 1999). Stark (2005) argues that with copyrights "individual software developers are still granted the rights to control duplication and distribution of their works", and "no single company can assert exclusive control over an idea behind a particular piece of software" Stark (2005, p.61).

As mentioned software patents have generated some ethical concerns for innovation. Critics to the status-quo of the patents system point out that "what is legal is not always ethical"

[14] Frietsch et al. (2015, p.18)

[15] USPTO United States Patent and Trademark Office

Stark (2005, p.60). For instance, Stark (2005) argues that abuses of the IP law by software patent holders are putting in risk software innovation in the United States of America (US). The author discusses the application of ethical frameworks utilitarianism, duty-based ethics and rights-based ethic to software patents. Stark (2005) mentions that since the first patent granted to a software in 1981 the software industry is controlled by the big corporations, which are the owners of thousands of individual patents. By using cross-licensing, these corporations control the market making it very difficult to smaller and new companies to enter to the market, thus the software industry has shifted from being a field of great innovation to a field of "minefield of litigation, anti-competitive behavior and questionable ethics" due to patents (Stark 2005). The author alleges that software patents are inconsistent with the initial aim of the patent system, which is "rights of the general public". Software patents are creating a "landscape of litigation and technological stagnation". They slow down innovation (see also Bessen & Hunt 2007), increase costs to the public, and last longer than the usefulness of a vast majority of software. Patents should be a tool to foster innovation and broader public knowledge, when patented inventions become part of the public domain.

The necessity of patents in the software industry has been questioned by some authors. For instance Graham and Mowery (2005) found it difficult to support the claim that strong patent protection is vital for software innovation due to the long history of innovation of the sector. Moreover, they suggest that innovation in this technology may be being blocked due to the use of different forms of strategic patenting. However, the lack of strong evidence to this suggestion is acknowledge by the authors. The weaknesses of the quality control procedures was found to be a concern.[16] Graham & Mowery (2005) also mentioned the difficulties of finding and applying a policy solution to the problem of software patents without having the risk of causing more new problems. However, Hall & MacGarvie (2010) show that the negative impact of software patents on companies' market value has changed into a positive impact.

In addition to the critics that strategic patenting might be slowing down innovation in the software sector, there is the critique of knowledge protectionism from patent holders. One specific case is the implication of patents of computer algorithms on the course management software for distance learning Moreau (2008). It is argued that distance learning should develop freely from unhindered software patent.

[16] Quality control procedures within the U.S.

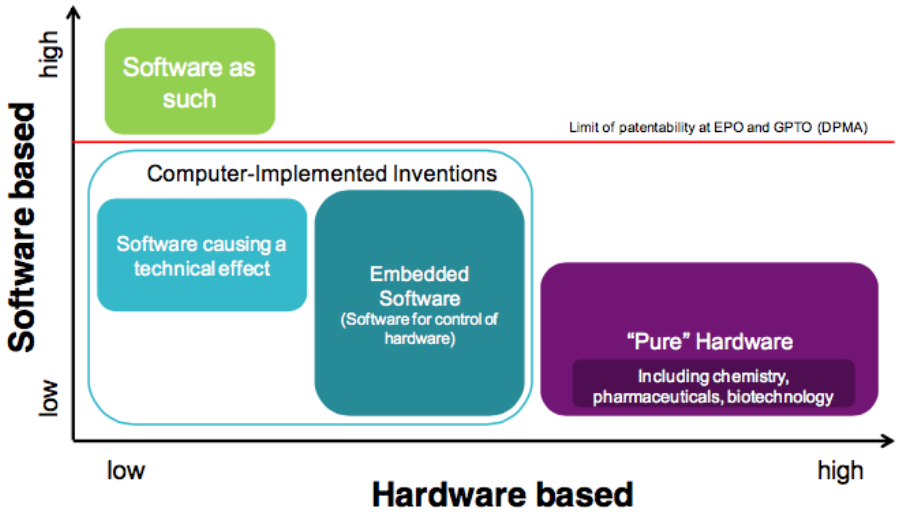

Figure 1 Graphical representation of the definition of Computer –implemented inventions (CII) Source: Frietsch et al. (2015)

Summarizing the literature about software patents, it has to be observed that several economic and legal studies have been published after the change of the patent regime. However, the ethical aspects have only be addressed to a very limited degree (e.g. Douglas 2011).

4.3.2 Patent-related ethical implications for employees

One perspective of ethics in patents in ICT hat has been covered in the literature is the one regarding the measurements taken by companies to avoid ethical issues on patents from their engineers. Engineers deal with patents while working as inventors of products, while working on features or processes, or at product comparison and product making.

Schoedel (2014) studied the actions taken by companies in United States of America to prevent ethical confrontations and lawsuits due to patents. The author presents some guidelines of actions to consider for engineers working in these tasks. For instance, American companies have incorporated ethical codes (e.g. IEEE Code of Ethics[17]) to be followed by their employees, which cover ethical issues facing inventors of products, features or processes. In the process of obtaining a patent all inventors muss sign an oath or declaration of their invention, and it must represent the truth. Often engineers are asked to compare their company's products with other company's patent and they are expected to "be honest and realistic in stating claims or estimates based on available data"[18] According to Schoedel (2014), The engineer should consider the importance of the comparison since it might be due to that the company is: (1) being sued for patent infringement; (2) receiving a letter suggesting that the company needs a license to a patent; (3) researching technical capabilities it wishes to purchase and/or license; (4) determining whether it should enter a new market or sell a new product; (5) performing a competitive analysis; or for other reasons. More importantly, Schoedel (2014) mentions that the engineer should inform the

[17] IEEE Code of Ethics www.ieee.org/about/corporate/governance/p7-8.html

[18] Based on the ethical code of the company (e.g. IEEE code)

requester if he/she is incapable of performing the task or requires additional information, in the case the patents are difficult to understand or are poorly written.

For the case of product making Schoedel (2014) argues engineers should follow the "duty to mark"[19], which states that all patented products to be sold should be marked either with the patent number or an Internet link to product to prevent patent owners from misleading the public. The aim of the "duty to mark" is i) to protect the companies at the moment of recovering damages; ii) to sanction the companies when there is a failure on the marking or a false marking of the product (i.e. false number or false "patent pending" note); and iii) to protect the public. Here engineers have to agree in accepting responsibility in "making decisions consistent with safety, health, and welfare of the public" in Schoedel (2014) from IEEE code.

An example of a company offering a commitment not to use patents for offensive purposes without inventors' permission is Twitter's Innovator's Patent Agreement.[20] With this agreement Twitter keeps some control in the hands of engineers and this way intends to avoid ethical issues by employees on the use of their inventions.

4.4 CONCLUSIONS OF THE REVIEW ON ETHICS AND PATENTS

There is little amount of literature covering specifically the issue of ethics and patents in the ICT. Most of the literature found is on patenting software and its consequences, addressing ethical issues. The additional literature identified addressing specifically the issue of ethics and patents was focused on the bio science and medicine field. In most of the papers the negative consequences of misuse of patents and patent law are pointed out by the authors. The critics include the discrepancies between the original purpose of patents and the actual use of them are mentioned. There is some critical analysis of the ethical inconsistencies of the patent system referring to the specific case of software. A number of authors consider that ethical issues should be taking into account into the patent system. However, there are also authors who defend the current state of patent law. This literature review shows the need of investigating issues of ethics and patents in the ICT sector.

[19] The "duty to mark" in the U.S. is foster by the U.S (35U.S.C.§287)

[20] https://github.com/twitter/innovators-patent-agreement; https://blog.twitter.com/2012/introducing-the-innovator-s-patent-agreement

Table 1 Overview of the literature on ethical aspects of patents

ARTICLE	CATEGORY	FOCUS OF THE STUDY
KARBOWSKI & PROKOP (2013)	Business / Company´s perspective	Critical retrospective analysis of economic arguments for patent protection of inventors, and the use of patent protection laws in business strategies.
STRAUS (2015)	Conceptual problem / Genetic	The conceptual problems of the current system
SPŁAWIŃSKI (2005)	Patent system / General	Use of patents as an unfair instrument against society
SONDERHOLM (2012)	Access problem / Medicine	Overview of the ethical problems raised by intellectual property rights
DRYSDALE (2004)	Ethics of inventions / bioscience	Possible misconceptions about patents and the role of the patent system
LEMLEY (2015)	Conceptual problem	Definition of invention
BESSEN AND HUNT (2007)	ICT / Software patents	An empirical analysis of software patents
FRIETSCH ET AL. (2015)	ICT / Software patents	Effect of the abolition of patent protection for CII
STARK (2005)	ICT / Software patents	Abuses of the IP law form software patent holders and consequences for the US.
GRAHAM & MOWERY (2005)	ICT / Software patents	Necessity of patents in the software industry
HALL & MACGARVIE (2010)	ICT / Software patents	Software patents´impact on companies' market value
Zivojnovic (2015)	ICT / Software patents	Evolution of the jurisprudence
MOREAU (2008)	ICT / Software patents	Implication of patents of computer algorithms
DOUGLAS (2011)	ICT / Software patents	Analysis of ethical aspects of software patents
SCHOEDEL (2014)	ICT / Ethics in engineering	Actions taken by US companies in to prevent ethical confrontations and lawsuits due to patents.

5 OVERVIEW ON OPEN ACCESS AND PATENTS

"The greatest challenge will be to create a 21st century world that brings technological freedom: the freedom to understand, study, tinker with, improve, modify, share, keep and teach others what we know. Having grown up with technology, we know that... it enables society to share knowledge, to share liberty... Information is the root and infrastructure of freedom in the 21st century." Professor Eben Moglen of the Software Freedom Law Center in EPO (2007, p.74)

5.1 INTRODUCTION

ICT use and the Internet has made the world more interconnected allowing for the exchange of ideas and know-how. The Internet, a system based on openness, has changed our access to information. This access has led to an increase to new innovative ideas which has led to significant technological, social, environmental, economic and even political changes. Nowadays, there is a feeling that every person can be informed and can express their ideas. This new way of thinking and feeling requires more open access to protected goods, which are perceived as hindering innovation and detrimental to the wellbeing of the society. For instance, there is a demand by patients for cheaper patented medicines (see Godoy 2015), from consumers for open access to patented goods and scientist for access to patents blocking research. In the ICT sector, programmers have been working on establishing an alternative to the traditional owners of IP software by pushing forward open source projects. There is clearly criticism directed at a a patent system that aims at blocking general access. Even worse, in the last decades the patent system has moved form patenting technological innovation towards also patenting basic knowledge incl. strategic patenting (e.g. Blind et al. 2006) as well as producing low quality patents (EPO 2007, Van Pottelsberghe de la Potterie 2011). These trends further worsen the possibility of accessing knowledge and strengthens the position of patent holders. Thus, the original purpose of patents, to balance the interests of society with those of the individual and to foster innovation, is being questioned.

As a way of tackling these patent monopolies, movements have emerged with the aim of opening the access to knowledge and patents to all. Some of these movements are as first example instance the Access to Knowledge (A2K[21]), which is a "movement takes concerns with copyright law and other regulations that affect knowledge and places them within an understandable social need and policy platform: access to knowledge goods" [22] (see Figure 2).

[21] Access to Knowledge http://www.cptech.org/a2k/

[22] Access to Knowledge http://www.cptech.org/a2k/

The A2K Treaty (2015) recognizes three basic problems:

i) innovation particularly in the ICT sector is being harmed by the restrictions of the IP system;
ii) goods of knowledge based on IP such as research journals or software are highly costly, particularly affecting poor countries and their citizens by price restriction to access;
iii) developing countries are the most affected ones with the one-size-fits-all over IP system (EPO 2007).

Secondly, 'Software Movement (FSM)[23]' represents the rights of freedom for software users. Supporters of the FSM include the 'Free Software Foundation (FSF)[24]', 'Open Source Movement (OSM)', and the 'Open Source Initiative (OSI).[25]' Finally, 'Access2Research[26]' is a campaign for academic journal publishing reform and 'Access Campaign[27]'is a campaign promoting access to essential medicines.

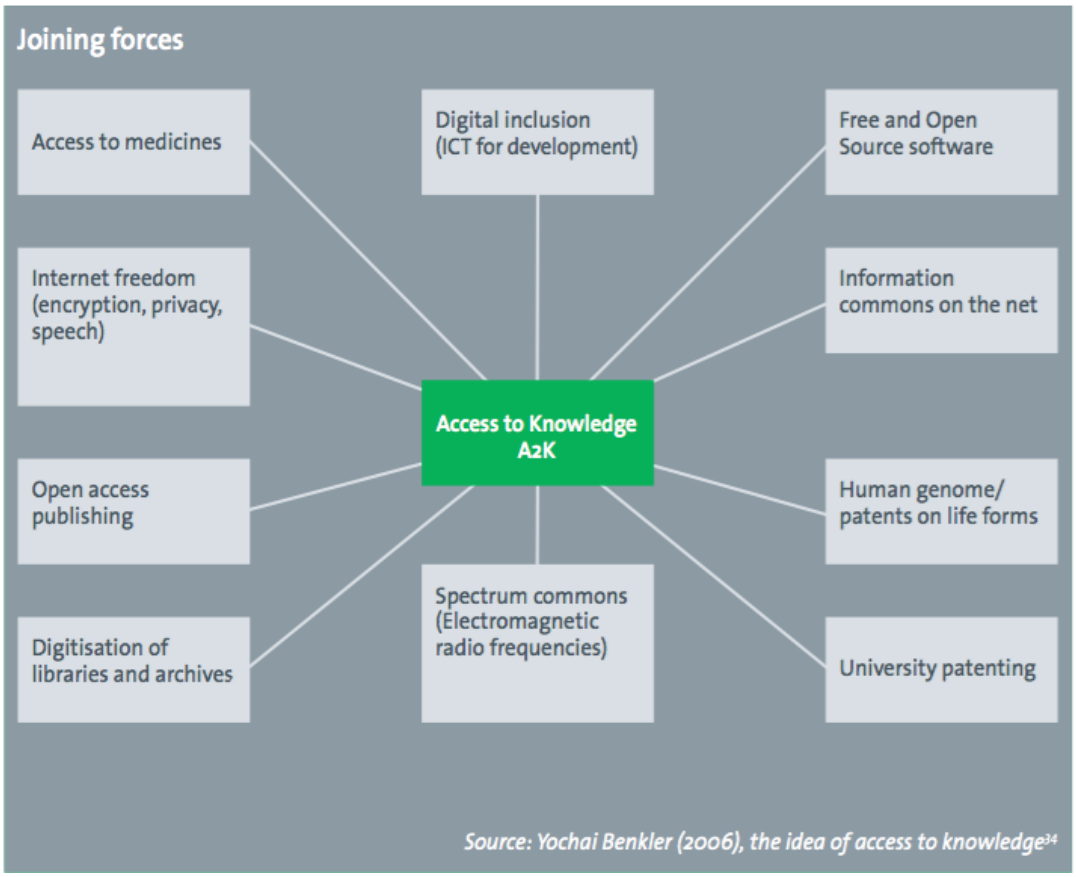

Figure 2 The joining forces of the A2K movement. Source EPO (2007, p.74)

[23] Also called Free/Open Source Software Movement (FOSSM) or Free/Libre Open Source Software (FLOSS)

[24] The Free Software Foundation (FSF) "is a nonprofit with a worldwide mission to promote computer user freedom. We defend the rights of all software users" https://www.fsf.org/ in Europe http://fsfe.org/activities/wipo/wiwo.en.html

[25] Open Source Initiative https://opensource.org/history

[26] http://access2research.tumblr.com/press

[27] https://www.msfaccess.org/the-access-campaign

These movements are the result of events occurring at the international level such as the Geneva Declaration (2004) addressing the World Intellectual Property Organization initiated by the governments of Brazil and Argentina and supported by hundreds of organizations and individuals. It points to the global crisis being faced by humanity in the governance of knowledge, technology and culture. Its manifestation being according to the Geneva Declaration (2004, p.1):

- Without access to essential medicines, millions suffer and die;
- Morally repugnant inequality of access to education, knowledge and technology undermines development and social cohesion;
- Anticompetitive practices in the knowledge economy impose enormous costs on consumers and retard innovation;
- Authors, artists and inventors face mounting barriers to follow-on innovation;
- Concentrated ownership and control of knowledge, technology, biological resources and culture harm development, diversity and democratic institutions;
- Technological measures designed to enforce intellectual property rights in digital environments threaten core exceptions in copyright laws for disabled persons, libraries, educators, authors and consumers, and undermine privacy and freedom;
- Key mechanisms to compensate and support creative individuals and communities are unfair to both creative persons and consumers;
- Private interests misappropriate social and public goods, and lock up the public domain.

The Geneva Declaration strongly criticizes the work of WIPO. Privileging those with power and disregarding those in need as well as its weakness in the control of anti-competitive practices and the protection of consumer rights. Consequently, the supporters ask for a moratorium on new treaties and harmonization of standards that expand and strengthen monopolies and further restrict access to knowledge (Geneva Declaration 2004, p.2). In the past, the concerns of powerful publishers, pharmaceutical manufacturers, plant breeders and other commercial interests were the focus of WIPO's work. Recently, WIPO has tried to widen this narrow focus to become more open to civil society and public interest groups. However, the substantive concerns of these groups, such as the protection of consumer rights and human rights, have yet to be addressed.

The Geneva Declaration has opened up a discussion regarding the development of an agenda for the future on WIPO and the IP system in general. As a result of the debate that followed the Geneva Declaration, a 'Treaty on Access to Knowledge and Technology (A2K Treaty 2005)' was drafted. Regarding patents, the treaty states that the privileges granted by a patent shall not be interpreted to prohibit experimental use, research, improvements in the same field as the patented technology nor prevent the temporary, free distribution of medicines for urgent health care. The treaty also proposes to condition the granting of a patent on the disclosure of the best mode of practicing the invention. In addition, a commitment to ensure the transfer of know-how after the expiration of the patent, the disclosure of the source/origin of any biological material utilized, disclosure of any government financial support received and the commitment to make available a deposit of any associated biological materials for general use after the expiration of the patent.

All these movements show that the society is heading towards an open system in which the right to share and access those resources by all, is pivotal for the well-being of the society.

The current patent system considers only the costs of the inventions, rewarding inventors by giving them the exclusive rights on their inventions without considering the cost to society termed 'deadweight' (Schovsbo 2009). 'Deadweight' is associated to the high cost that society has to pay for patented inventions and processes (e.g. medicines) and for finding other means for innovation not protected by patents. Schovsbo (2009) argues that the system should find a balance between the private and the social costs. There are movements towards a rebalance. For instance, legislation which had previously promoted the incentives related to patents, such as the prolongation of patent protection, the expansion to all fields of technology, or the implementation of the TRIPS to developing countries. Currently, the tendency has been to reduce the benefits for patent owners due to the increase in skepticism regarding the IPRs system, especially TRIPS. There is the aim to avoid that firms using options of competition law hinder the development of other innovations, prevent competition, or set high fixed price agreements.

Limiting access to protected technologies can drive the so-called 'tragedy of the anticommons'[28] which happens when there is an overlap of rights on certain knowledge leading to the underuse of this protected knowledge (Heller 1998). The tragedy of the anticommons can be generated by breakdowns such as patent thickets or submarine patents, i. e. patent whose issuance and publication are intentionally delayed by the applicant for several years. However, some authors argue that the overlapping of rights on certain knowledge areas should not be a concern (e.g. Jacob (2008) in Schovsbo (2009 p. 612). Overall, access to patents is seen as essential for innovation.

This section presents an overview of the literature on open access and patents and in particular, on open source software.

5.2 LITERATURE ON OPEN ACCESS AND PATENTS

5.2.1 Tools to facilitate access to patented inventions

Strategies tackling with the problem of access and the tragedy of the anticommons focus on the pre-grant phase (inside of the patent system) and the post-grant phase (outside the patent system). The pre-grant phase includes an increment of the `bar', which is the patent requirement with the objective of granting less number of patents to prevent thickets. It is of concern that patent thickets are the result of too many granted patents (Schovsbo 2009). Consequently, at the post-grant phase initiatives focus on limiting the scope of patents as well as implementing patent pools or clearinghouses.[29] Schovsbo (2009) analyzes the use of some

[28] Anticommons is defined according Heller (1998, p. 622), when "multiple owners are each endowed with the fight to exclude others from a scarce resource, and no one has an effective privilege of use. When there are too many owners holding rights of exclusion, the resource is prone to underuse".

[29] According to Aoki and Schiff (2008, p. 195-196) "A clearinghouse is like a middleman in the market for technology that facilitates exchanges between IP owners and IP users..", which could also facilitate licensing

post-grant measures to increase access to patented inventions including, compulsory licensing, licenses of rights, and behavioral rules. These measures are those Schovsbo (2009) considers should be included in the patent legislation of the European Union seeking to limit access to patented inventions.

The compulsory licensing is when access to a patent is imposed by law, for instance when it is proven that the patent is preventing innovation, is unjust, or excludes competitors. The compulsory rule facilitates access yet, reduces incentives for innovators to patent.

The 'Licenses of rights' model is when the patent holder opts for changing his exclusive rights for liability rules, i. e. the rightholder receives only a remuneration right to receive compensation for the use of its protected creation or invention. The patent holder makes an agreement with any potential user that provides payment or an 'appropriate return'. However, to avoid misuse by the patent holder, the 'licenses of rights' model sets the return by a third public institution, for instance a Community Patent Court, and the patent holder loses their exclusive licenses (Schovsbo 2009). The model seems to have a positive effect on access, yet only for patents with relatively low value. Some authors suggest making the licenses of rights model compulsory for certain categories of patents pertaining to basic knowledge, e.g. software (Hilty and Geiger 2005 in Schovsbo 2009 p. 615) or medicine patents (Flynn et al. 2009). However, this would require a fundamental change in the patent system, a system based on liability rather than on exclusivity. The behavioral rules aimed at avoiding `patent trolls' for instance, amend the patent law to make compulsory the use of patents by the patents holders.

The presented supportive mechanism to post-grant initiatives fostering access may benefit both the inventor and the patent user. Schovsbo (2009) argues that by having a clearer position of the patent law on post-grants initiatives, inventors can make more informed decisions on the acquisition and later use of the patent. Furthermore, potential patent-users could have easier access to the patents. Yet, the presented supportive mechanism favors liability over exclusivity. The author points out that the patent system should not favor any of the two systems but rather, should choose the solution based on the social benefits and cost in `Community Patent system'.

5.2.2 Access to patents of basic knowledge

One critical case of access to patents is the case of patents of basic knowledge, which are often broad patents. These kind of patents are problematic, since they can block the access to basic knowledge essential for creating innovations, which are not necessarily directly related to the original patent. There are examples of patents of basic innovation in the field of genetics in which patents on genes with a broad scope block any further innovation that includes any of the patented genes. The consequences of these patents is strong monopoly power for the patent owner and high costs for the potential users, which may opt to ignore the patent. 'Myriad Genetics' patents mentioned by Trommetter and Tropeano (2014) for example, have faced opposition reducing their scope and resulting in high litigation costs for the patent holders.

including the collection of royalties and monitoring of uses on behalf of the patent holders. In principle, such organisations could raise revenues from both IP owners and IP users for its services.

A possible way forward is `paid open access'. Here one pays the patent owners a fee to maintain open access to their patents, a concept derived from Gadaud and Rambonilaza (2010) in Trommetter and Tropeano (2014, p. 504). Trommetter and Tropeano (2014) studied the choice between secrecy, patenting and open access of basic innovations, and the incentives behind the companies for choosing one or more of the options. In short, firms holding basic knowledge have three options: patent, paid open access or secrecy. Trommetter and Tropeano (2014) argue that paid open access could be promoted by patents. The authors analyzed how the incentive to share basic knowledge through paid open access have been influenced by the prohibition of patents of basic innovation. They argue that firms who posess knowledge and who would opt for the patent option would also agree to a paid open access fee. This is because holders of patents of basic innovation, i.e. broad patents, are apprehensive of paying high litigation costs and losing trials. They would opt for an ex-ante knowledge sharing agreement such as 'paid open access' over an ex post license contract. The results of Trommetter and Tropeano (2014) are interesting as they show that despite the contradictions inherent in the terms 'patent' and 'knowledge sharing', access to knowledge is easier, if there is a patent on the basic innovation. The paid open access is in this case presented as a solution, which would benefit both patents owners and potential patent users. However, Trommetter and Tropeano (2014) also mentioned that the firms with a basic knowledge innovation might also opt for secrecy instead of patenting.

5.2.3 Institutions promoting open access to patents

Aoki and Schiff (2008) studied the initiatives aimed at promoting access to patents in a 'market for technology`[30]. The central transaction is made by a third party, such as patent pools, clearinghouses, and copyright collectives (see also Van Overwalle et al. (2006) focusing on the suitability of the instruments for patents on genetic inventions or Chi-Ham et al. (2012) for patents in agricultural biotechnology). In their work Aoki and Schiff (2008) present the advantages and disadvantages of these instruments. Patent pools work in general well for cases where there is a need of combined work to produce an innovation and the necessary patents are easy identifiable. However, its disadvantage is its limited scope. Clearinghouses such as copyright collectives have a broader number of IP and may be more stable than patent pools. Third-party clearinghouses, which reduce costs by not having a centralized licensing system, do not solve the problem of the anticommons. Third-party clearinghouses collect and disseminate information over the Internet, providing a `matching service' between patent owners and patent users instead of directly selling the licenses. However, Aoki and Schiff (2008) point out the need of a consistent framework for the comparison of the different systems, which allows for the assessment of the effects of the different systems on innovation and public welfare. Furthermore, even the positive effects of clearinghouses can be counteracted by licensors raising royalties. Moreoever, they are contingent on the number of intellectual property rights per downstream use as well as their substitutability (Aoki and Schiff 2010).

5.2.4 'Free revealing'

Niklewicz-Pijaczyńska (2014) presents an effective way to create a new solution in changing the closed innovation model to an open model for intellectual property called 'Free Revealing'. The closed innovation model is closely linked to the classical patenting system regarding knowledge, which promotes innovation driven by the incentives at the supply side.

[30] Derived from Arora, Fosfuri, & Gambardella (2001)

While, the concept of 'Free Revealing' created from the theory of open innovation (Chesbrough, 2008), is based on communication, a socially constructive factor. The model increases social welfare because it involves cooperation with users on the one hand and the completely free sharing of developed solutions and jointly created ideas on the other hand. Therefore, innovations are stimulated by the demand side.

Niklewicz-Pijaczyńska (2014) presents the advantages of the 'Free revealing' model which seeks a direct collaboration across parties (located both in the supply and on the demand side). Companies with similar potential and experience are able to generate and stimulate innovative solutions together focusing on societal needs by using their ability to skillfully communicate with users. The model tries to reduce the bureaucratization of the patent system. However, companies can obtain property rights. In fact, they are free to provide "open licensing" to third parties under the concept of centrifugal[31] (outside – in open innovation) and centripetal [32](inside – out open innovation) open innovation. Moreover, Niklewicz-Pijaczyńska (2014) suggest that the 'free revealing' model may be the optimal solution for the ICT sector, reducing overlapping patents and patent tickets.

5.2.5 The "Private-Collective" Innovation Model

The previous mechanisms and institutions address the access to already existing patent-protected know-how. However, the production of technological know-how has meanwhile shifted from the paradigm of closed to open innovation (Chesbrough 2008). This type of "private-collective" innovation model result in innovations that indeed can offer the best of both worlds to society. Innovators use their own resources (mostly time) to privately invest in creating new knowledge (e.g. novel software), which is then offered freely to all. Von Hippel and von Krogh (2003) studied the components of open source projects to create the "private-collective" model by combining two models that encourage innovation in different directions: the 'private investment' and the 'collective action model'. In the first one the society encourage innovation by granting IPR to inventors, i.e. copyrights. The second one, however, avoids the social loss problem or issues associated with static efficiency due to the requirement of contributing to software projects, which will become public goods by supplying their own contributions into a "common pool".

Bogers, Bekkers and Granstrand, (2012) present the advantages of the "private-collective" model, which has important implications for negotiations and expected compensations. Innovation collaboration can serve as building blocks, since everybody is open to collaborate, own and share their work. The way that each can get benefits is linked to the idea of licenses by modules, allowing for an umbrella of agreements between the multiple partners. However, the way to have transparency in the umbrella of agreements is with the control by a "hug organization". Bogers, Bekkers and Granstrand, (2012) claim that this can also be an effective way to deal with patents and licensing issues, e.g. the model consortium agreement of the "European Framework Programmes", that generally over-specify the terms (European Commission, 2002).

[31] The centrifugal form is a collaboration with external stakeholders to implement projects.
[32] The centripetal form is sharing of knowledge to others through contracts, alliances, new forms of cooperation such as outsourcing.

Within the various types of open innovation models, access to IP varies. According to Nystén-Haarala et al. (2010) there are three degrees of openness of open innovation models in the ICT sector (see Table 2). In the case of firms practicing open innovation for profit, the innovation exchange is likely to be transactional, i.e. firms either seek to buy or license IP. In contrast to the co-creation network, the innovation are the type of not for profit, e.g. "Open source". Even in this case, the exchange modalities are controlled through mandatory IP law, contracts, norms or rules of community participation. Furthermore, between both lies a hybrid open innovation network, i.e. the co-creation of "standards", where IPs are pooled or cross-licensed. In terms of regulation, in all these open innovation networks, a proactive private self-regulation is necessary to organize the interface between IPR with open innovation. For example, through contracts managed by a third party the open innovation process will become transparent.

Table 2: IP Strategies and Open Innovation (Source Lee et al. 2010)

Open?	Overal IP Strategy	Appropriation Strategy	Contracting Strategy	Disputes Strategy	Revenue	Sector	Example industry
transaction network (Close)	Exclusive	File for Core Patent Copyright	No licensing (restrictive terms)	Aggressive litigation	Extreme (none or huge)	Other	Traditional Original Equipment Manufacturers, Pharmaceuticals
transaction network/ co-creation network (Mixed)	Leverage	Patenting in rivals' key area Buy patent Copyright	Willing to license out Licensing platform/pool	Threat to sue (to induce license)	Rules of Association	ICT	Continuous Telecom & Standardized technology
transaction network/ co-creation network (Mixed)	Defensive	Patent race Opposition (rivals)	Cross licensing	Defensive litigation, (Counter Suit, Invalidation)	Almost none		Electronics. (semiconductor), Telecom.
		Copyright where relevant	Limited license in	Defensive Publication			
co-creation network (Open)	Defensive "Open source"	Copyright No patent filing Publish	Open License	Threat to sue to induce compliance of licensing terms & Community Norms	No royalty from IP		Information Technology & Software

5.2.6 The Example of Free Open Source Software in Detail

One of the most clear examples of open access is the case of Free and Open Source Software (FOSS). As defined by Richard Stallman (Stallman 2002, p.3) and the Free Software Foundation, Free Software is the code that respects four different freedoms. These include running the program as the user wishes, studying the source code of the program and the freedom to change it, be allowed to redistribute copies of the program as well as to distribute copies of modified versions. As it can be noted they allow any user to have access to the technology by reading the human understandable source code, as opposed to machine

understandable complied code, as well as to use the technology and perfect it. It should be noted that the term "free" does not mean that distribution of free software is cost-free.

The previous rights are granted by virtue of licenses such as GPLv3[33] or Apache 2.0[34] attached to the code. Some of these licenses, the so-called copyleft licenses such as GPLv3, have clauses to ensure a viral effect, that is, that software derived from free software remain free software. As software is protected by copyright, it is precisely based on this type of IPR on which the licensing terms and especially, the viral effect is accomplished. In fact any licensee that breaches any of the licensing terms would be violating the copyright's holder exclusive rights (Boettinger and Burk 2004, p.224).

Lerner and Tirole (2005, p. 102-105) describe different reasons motivating individual contributors to dedicate their efforts in open source projects instead of a paid job. The reasons include intrinsic pleasure to work on a project of their personal interest, ego gratification from peer recognition and the opportunity to improve their skills, that together with the visibility may lead to future job offers. Furthermore, Gault and Hippel (2011) propose an additional motivation for those individuals or organisations that pass free of charge pass developed solutions to others by the introduction of changes in innovation policies through the introduction of tax incentives similar to the deductions applicable to the R&D.

5.2.7 Extending the Open Source Model to Utility Inventions

Unlike in the software case where there are well-known proven open source licenses to give up some of the rights owned by the copyright holders, in the case of the utility inventions there is no default and widely recognized way for patent owners to give up some of the rights over their patents whilst reserving others to themselves. On the opposite, from all the levers that the patent system has for promoting the diffusion of knowledge, many of them are currently set to default to exclusion (Chien 2015).

Contreras (2015) also recognizes this gap as well as some of the current issues of patent pledges and has proposed creating a public registry of patent pledges to address these issues and challenges. The public registry would increase the visibility of patent pledges and be permanent. It would be a less volatile way of publishing pledges (e.g. by blogs) and also, could help to enforce the successors in interest for pledged patents to abide by the pledge's commitments.

Boettinger and Burk (2004) explore the concept of open source patent licensing. The authors provide some examples in the biotech industry in which a model similar to the copyleft open source licenses, are put in place. For instance, providing licenses on a tool under the commitment to license any improvements to the tool under the same terms. The authors come to the conclusion that open source patent licensing is legally viable as long as the idiosyncrasies of the patent system and competition law are regarded and respected. One of the differences between software protected by copyright and inventions protected by patents is that, whereas the former does not require to make the source code public, the latter inherently accomplishes the goal of making inventions public (after the 18 months

[33] https://www.gnu.org/licenses/gpl-3.0.html

[34] https://www.apache.org/licenses/LICENSE-2.0

when the publications usually happens). This is at least theoretically the case, as some biotech inventions may require depositing materials in a publicly accessible repository to make the invention effectively available to the public. Another pecualiarity of the patent system is that it is designed to reward successive inventions that build on its predecessors, which can qualify as a new patent if they are inventive enough, with a danger of blocking new innovations.

Boettinger and Burk (2004) further teach that open source patent licenses could resemble to a certain extent some of the conventional patent licenses. For instance, similarly to "grantback" licenses that require the licensee to grant back to the licensor of a patent a license to potential improvements of the technology. In the context of open source patenting a license may deter patenting follow-on improvements or at least limit its assertion ("reverse grantback"). Open source patent licensing may also resemble "reach-through" licenses under which the patent owner grants permission to use the invention conditioned on royalties for follow-on inventions. The open source version ("reverse reach-through") could be considtioned on the licensee not imposing royalties on follow-on developments.

Schultz and Urban (2012) propose the Defensive Patent License, under which every licensor offers its whole portfolio to other DPL licensors, subject to the conditions that no offensive patent infringement action will be taken against any other DPL users. DPL licensees are binding for successors-in-interest. A DPL user may stop offering their patent under DPL but it may not revoke any license in place and is exposed to other DPL users revoking the licenses granted to said former DPL users. The DPL licensing became a reality 35 but it has at this point just a few users and thus has not reached the required network effect so far.

5.3 CONCLUSIONS OF THE REVIEW ON OPEN ACCESS AND PATENTS

The patent system is based on a compromise that requires the inventor to make an invention public in exchange to a temporal exclusion right. Multiple tools have been proposed and put in place to favor the licensing or waiver of the exclusion right so that an invention can be used by parties other than the patent owner. Some of these tools have proven to be useful in some cases but they all present some issues and challenges. A peculiarity of all these systems is that they are usually built "around" the patent system, instead of as an integral part of it. There seem to be some room to explore to what extent the patent system could provide the tools to maximize the open access to the patented technologies, to the extend that patent owners opt to waive some of their exclusion rights.

[35] https://defensivepatentlicense.org/license/

Table 3: Overview of the literature on open access and patents

ARTICLE	CATEGORY	FOCUS OF THE STUDY
SCHOVSBO (2009)	Open access to patents	Access to patented inventions via different measures
TROMMETTER AND TROPEANO (2014)	Open access to patents	Study on the choice between secrecy, patent and open access of basic innovation
AOKI AND SCHIFF (2008)	Open access to IP	Reviewed patent pools and IP clearinghouses as systems that promote access to IP
AOKI AND SCHIFF (2010)	Open access to IP	Reviewed IP clearinghouses as systems that promote access to IP
NIKLEWICZ-PIJACZYŃSKA (2014)	From close to open access IPR	Combination of IPR and concepts of free revealing (free access) and open innovation (open invention)
CHESBROUGH (2008)	From close to open access to patents	Open Innovation
VON HIPPEL AND VON KROGH (2003)	Private-collective innovation model	Open source software
LERNER AND TIROLE (2005)	Open access to software	Economic approach to open source licensing
CHIEN (2015)	Open access to patents	Fostering knowledge diffusion aspect of patents
CONTRERAS (2015)	Open access to patents	Patent pledges as a mechanism to waive some of the rights of patents (e.g. exclusion)
BOETTINGER AND BURK (2004)	Open access to patents	Study about viability of copyleft licensing for utility patents
SCHULTZ AND URBAN (2012)	Open access to patents	Defensive Patent Licensing

6 CONCLUSIVE REMARKS

Based on the assumption that 'ethical issues' and 'open access' are two relevant aims of the five aims of the Responsible Research and Innovation (RRI) approach of the EU Program for Research and Innovation of the European Commission, the relevant literature related to ICT has been reviewed.

In a first part, the recent discussions about ethics of ICT in general have been summarized. The review of the literature related to ethics and patents in particular revealed and confirmed on the one hand that the patent literature is focused on the bio science and medicine field. On the other hand, the very few studies in the field of ICT is strongly concentrated on software patents. However, some work has been identified, which addresses the ethical aspects of ICT without considering the role of patents. Consequently, there is obviously a research gap in the ethical aspects of ICT patents, which will be addressed in the following empirical work conducted within CIFRA, but relying on the performed review of the literature, especially about the insights on the ethics of patents in bio science and medicines to be transferable to ICT. Despite the initial differences of the role of patents in the pharmaceutical technology in comparison to their function in ICT, we observe some convergence. First, ICT is becoming more relevant in pharmaceutical research and the discrete character of pharmaceutical research and innovation are moving towards a higher complexity like ICT innovations. Secondly, ICT is becoming as basic infrastructure more relevant for citizens' life complementing life-saving pharmaceuticals for individual patients. Therefore, including the ethics of patents on pharmaceuticals as means to safe or expand lives into the analysis of the limited literature on the ethics of ICT patents contributes to expanding our insights on the latter.

The second part addresses the open access dimension of patents taking into account that phe patent system is based on a compromise that requires the inventor to make an invention at least public in exchange to obtaining a temporal exclusion right. This trade-off has already been addressed in the general review of the literature. The review reveals different strategies, tools and institutions to promote open access to patents. In addition, the common production of knowledge and its open distribution, like successfully established within the Open Source paradigm, represents another option to foster open access to patent protected knowledge, like patent pools as solutions already presented in the general literature review. However, all these solutions are not integral part of the patent regime, but built "above" or "around" of it. Therefore, the following work has to explore opportunities to what extent the patent system itself could provide to the open access to patents.

Finally, the investigation of possible solutions has to address the challenge not only to find a balance between the inventors' rights and incentives and the implementors needs to get access to patent protected technologies, but also to include the missing ethical concerns.

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